STRESS MINDSET, COGNITIVE APPRAISALS, AND SPORT INJURY:

A TEST OF THE STRESS-INJURY MODEL

by

Lindsey Hamilton

A thesis submitted to the faculty of
The University of Utah
in partial fulfillment of the requirements for the degree of

Master of Science

Department of Exercise and Sport Science

The University of Utah

August 2015

The University of Utah Graduate School

STATEMENT OF THESIS APPROVAL

The thesis of **Lindsey Hamilton**

has been approved by the following supervisory committee members:

Leslie W. Podlog	, Chair	**May 1, 2015** Date Approved
Maria Newton	, Member	**May 1, 2015** Date Approved
Robert J. Sibthorp	, Member	**May 1, 2015** Date Approved

and by **Janet Shaw** , Chair/Dean of

the Department/College/School of **Exercise and Sport Science**

and by David B. Kieda, Dean of The Graduate School.

ABSTRACT

Over 12,500 injuries occur at the NCAA collegiate level every year. According to Williams and Andersen's stress-injury model, appraisals of stress in competitive situations may result in a stress response (attentional disruptions and physiological decrements), which heighten athletes' risk for injury. Personality, history of stressors, and coping resources are also posited to moderate the strength of the stress response and the subsequent likelihood of injury. In testing the model, researchers have generally examined direct relationships between so-called "moderator" variables and injury occurrence. Much less attention, however, has been paid to the attentional and physiological mechanisms that are predicted to mediate the stress appraisal-injury relationship. In particular, researchers have seldom assessed the influence of athlete stress appraisals on injury occurrence immediately prior to the athletic event. Furthermore, there has yet to be any examination of how an athlete's stress mindset (a general orientation towards stress as facilitative or debilitative) might increase or decrease the strength of the stress response and consequent risk of injury.

The purpose of this research, therefore, was to examine the moderating influence of athletes' stress mindset on the relationship between stress appraisals and injury occurrence. One hundred ninety-three collegiate athletes from NCAA Division III schools completed measures assessing their stress mindset and cognitive appraisals of a sport-specific competitive event. The stress mindset was measured using the stress

mindset measure, while cognitive appraisals were assessed immediately prior to one competitive event using the demand and resource appraisals questionnaire. Injury occurrence (defined as missing at least one single day of training or competition, or experiencing modified participation for one or more days) was documented by sport medicine staff. Moderation analyses using logistic regression were conducted to examine relationships of interest. Findings demonstrated that athletes typically appraised their competition as not stressful and generally perceived stress to be debilitating. Furthermore, no significant relationships between cognitive appraisals, stress mindset and sport injury occurred. While results of the present study were nonsignificant, understanding the precursors to sport injury remains a crucial topic to both understand and ultimately prevent sport injury so that athletes can safely participate in collegiate sport.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

Many people have provided valuable guidance throughout the development of this research. First, I want to offer appreciation to my committee chair, Dr. Leslie Podlog, who has encouraged me to think critically about this project from the beginning, and challenged me to become a better writer and scholar throughout my time under his advisement. I would also like to acknowledge the other members of my thesis committee, Dr. Maria Newton and Dr. Jim Sibthorp. They have provided valuable insights and critical feedback, which added new perspectives and helpful edits.

I would like to extend my thanks to Craig Bennett at the University of Puget Sound for his insurmountable support and assistance in the data collection process. Additionally, I would like to thank my fellow sport psychology graduate students who have provided me with helpful feedback and advice. Special thanks to the Department of Exercise and Sport Science for awarding me the Robert O. Ruhling Scholarship, so that I could continue my work and complete my degree.

Finally, I would like to express my sincerest appreciation for the unconditional support of my family. Many people near and dear to my heart made sacrifices in the pursuit of this degree and the success is truly theirs. A special thank you to Paul and Benjamin – you two endured the most hardship, but always responded with unending love, support, and adaptability. Thank you.

INTRODUCTION

On average, there are more than 12,500 sport injuries in NCAA collegiate athletics every year (Hootman, Dick, & Agel, 2007). Unfortunately, many athletes who incur an injury suffer from a range of debilitating physical, social, and psychological effects. In addition to the chronic pain and altered joint mechanics associated with sport injury (Dekker, van ver Sluis, Groothoff, Eisma, & ten Duis, 2003; Maffulli, Longo, Spiezia, & Denaro, 2010), athletes often suffer social challenges such as feelings of isolation from teammates and coaches (Abgarov, Jeffery-Tosoni, Baker, & Fraser-Thomas, 2012), decreased social support from significant others (Nixon, 1994), and a lack of social identity (Podlog & Eklund, 2006). Psychological consequences including mood disturbances, decreased self-esteem, anxieties over re-injury, and concerns about future performance capabilities may also be at the forefront of injured athletes' minds (Podlog & Eklund, 2007; Schwab Reese, Pittsinger, & Yang, 2012; Wiese-Bjornstal, 2010). Given the high injury rates at the collegiate level, and the debilitating effects of injury, an understanding of the factors that precede injury occurrence is of clear importance. In particular, a greater familiarity of injury antecedents is essential for prevention efforts and for reducing the deleterious consequences that typically ensue in the injury aftermath.

Physical fitness, individual biomechanics, and physical factors may all contribute to a potential sport injury. However, a growing body of research indicates that

psychological factors can also influence injury risk (Williams, 2001). In particular, it has been posited – and subsequently demonstrated in empirical studies – that stress may be a key factor implicated in injury occurrence. In an effort to conceptualize the impact of stress on injury vulnerability, Andersen and Williams proposed the stress-injury model (1988; revised 1998).

Within the model, it is suggested that a potentially stressful athletic situation (e.g., an important competition) may lead to a stress response, which heightens athletes' risk of injury. The stress response is characterized by two components: 1) cognitive appraisals of a situation as threatening (i.e., perceived situational demands outweigh personal coping resources); and 2) associated attentional consequences (e.g., attentional disruptions and narrowing of peripheral vision) and physiological impairments (e.g., increased muscle tension, fatigue, and reduced timing and coordination), all of which are suggested to increase athletes' susceptibility to injury. Personality, history of stressors, and coping resources are also posited to moderate the strength of the stress response, and the subsequent likelihood of injury.

Researchers examining links between variables articulated in the stress-injury model and injury occurrence have found fairly strong support for such relationships. With regard to personality variables, traits such as stress vulnerability (Johnson & Ivarsson, 2011), competitive anxiety (Ford, Eklund, & Gordon, 2000), type A behaviors (Fields, Delaney, & Hinkle, 1990; Nigorikawa, Oishi, Tasukawa, Kamimura, Murayarna, & Tanaka, 2003), and mood disturbances (Appaneal & Habif, 2013) have been linked to increased injury risk. Furthermore, an athlete's history of stressors, including negative life event stress (Appaneal & Habif, 2013; Rogers & Landers, 2005; Williams, 2001),

chronic daily hassles (Ivarsson, Johnson, & Podlog, 2013), and previous injury (Devantier, 2011) have, collectively or independently, been shown to increase injury likelihood. Finally, ineffective coping skills and limited coping resources, such as a lack of social support, have been shown to increase injury susceptibility (Johnson, 2011; Maddison & Prapavessis, 2005; Petrie, 1992; Smith, Smoll, & Ptacek, 1990). For instance, Petrie (1992) and Smith et al. (1990) demonstrated that, compared to athletes with high amounts of social support, athletes with low social support experienced more injuries.

Although an increasing body of empirical studies support suggested relationships between psychological variables and injury, few investigators have tested assumptions in a manner consistent with those initially proposed in the stress-injury model. For example, while researchers have typically examined direct relationships between "so-called" moderator variables and sport injury, no direct links between personality, history of stressors, coping resources and injury were ever espoused. Rather, such moderating variables were suggested to influence injury occurrence only insofar as they increased or decreased the likelihood of a stress response (i.e., threat appraisals and attentional/physiological changes) and consequent injury. Few investigators, however, have examined the influence of moderating variables on the attentional and/or physiological component of the stress response and subsequent injury. Moreover, researchers have generally failed to address the cognitive appraisal component of the stress response posited to mediate the relationship between a potentially stressful event and injury occurrence.

Of the studies that have examined stress response mechanisms, several have

found support for Williams and Andersen's model. For instance, Andersen and Williams (1999) found that athletes with high life event stress and low social support experienced greater peripheral narrowing during a lab-based stressor than athletes with lower life stress and greater social support, and that the former were more likely to incur an injury during the course of the competitive season. Similarly, Rogers and Landers (2005) found that soccer players who had elevated levels of game-day stress demonstrated a narrowing of their vision that increased their risk of injury. Together, these studies support contentions outlined in the stress-injury model suggesting that peripheral narrowing likely plays a role in the onset of acute injury.

As indicated above, the cognitive appraisals that an athlete makes regarding a potentially stressful athletic situation (e.g., an upcoming competition) are also a central component of the stress response, one that researchers have yet to examine empirically in predicting sport injury risk. Taking into consideration the numerous sources of stress that athletes may experience immediately prior to or during a competitive event (e.g., pressures to achieve success and anxiety about executing optimal performance [Lemberger, 2008], fear of injury [Evans, Hardy, & Flemming, 2000], self-presentation concerns [Podlog & Eklund, 2006], meeting performance expectations [Noblet & Gifford, 2002]), it seems prudent to investigate the influence of athletes' cognitive appraisals immediately prior to a potentially stressful competitive event on subsequent injury outcomes. Furthermore, within the scope of the stress-injury model, there has been no mention of the possibility that stress may − for certain individuals or in particular situations − reduce the risk of injury.

While the debilitating effects of stress have been documented at length, increasing

evidence suggests that stress may also be facilitative (Crum, Salovey, & Achor, 2013; Schneiderman, Ironson, & Siegel, 2005). For example, stress has been linked to increased cognitive performance (Cahill, Gorski, & Le, 2003), motivation and proactive problem solving (Norem & Cantor, 1986), and enhanced information processing (Hancock & Weaver, 2005). According to Crum and colleagues (2013), individuals may also possess a general orientation or disposition toward perceiving stress as facilitative or debilitative, what they referred to as a "stress mindset." The stress mindset "refers to the evaluation of the *nature of stress itself* as enhancing or debilitating" regardless of any one particular stressor (Crum et al., 2013, p. 718). From a conceptual standpoint, it is important to note that the stress mindset does not refer to a cognitive appraisal (Crum et al., 2013). While the stress mindset denotes the expectations and qualities attributed to stress in general, that is, a personality trait, cognitive appraisal refers to assessments of discrete, self-contained situations or events as more or less stressful (intensity of stress).

Of relevance to the present investigation, researchers have demonstrated the beneficial relationship between a positive stress mindset (stress-is-enhancing) and a more adaptive stress response. For instance, Crum et al. (2013) discovered that a positive stress mindset was associated with lower cortisol levels (i.e., a stress hormone) in response to a stressful scenario. Such results may be explained by the fact that individuals with a positive stress mindset may be more apt to appraise a situation as one in which they have the personal resources to meet the situational demands, which in turn influence hormonal responses such as cortisol. Applying these findings to a sport injury context, it seems plausible that individuals with a positive stress mindset might perceive that they have more resources to meet the demands of a stressful situation, thus diminishing a threat

response and decreasing the risk of sport injury.

Present Research

Taking into consideration the apparent benefits of a positive stress mindset, and to address limitations of previous stress-injury research, this investigation sought to answer three primary questions: 1) Do cognitive appraisals immediately prior to a game situation influence injury occurrence? 2) Does an athlete's stress mindset (i.e., a personality trait) moderate the relationship between cognitive appraisals of a potentially stressful athletic event and injury risk? 3) Does the stress mindset or cognitive appraisals predict previous injury? Given the practical challenges associated with assessing the influence of cognitive appraisals on attentional/physiological changes during the course of an actual game, no research aims regarding this component of the stress-injury model are forwarded.

With regard to question one, it was hypothesized that an athlete who appraises an upcoming game as threatening (i.e., greater perceptions of demands than personal resources) would be more likely to sustain an injury compared to an athlete who appraises the upcoming game as challenging (i.e., greater perceptions of resources than demands). In relation to question two, it was hypothesized that the stress mindset would significantly moderate the relationship between cognitive appraisal of an upcoming game and subsequent sport injury, such that a more positive stress mindset would weaken the relationship between more stressful cognitive appraisals and injury. Finally, in relation to the third question, it was hypothesized that the stress mindset and cognitive appraisals would significantly predict injury likelihood, such that a positive stress mindset and a less threatening appraisal of the game would decrease injury likelihood.

METHODS

Participants

Data were collected on 209 athletes from NCAA Division III university programs. One participant's data were excluded because they failed to fill out one of the questionnaires. After screening the remainder of the data for the exclusion criteria that all athletes would be uninjured at the start of the study, the final data set included 193 participants. Males ($N = 116$) and females ($N = 77$) ranging in age from 18-28 ($M = 19.75$ years, $SD = 1.425$) were examined across a variety of sports including soccer (105), football (50), basketball (26), and volleyball (12).

Measures

Cognitive appraisal. The demand and resource appraisals questionnaire (Mendes, Gray, Mendoza-Denton, Major, & Epel, 2007) was used to assess athletes' cognitive appraisals of the demands of an upcoming game, that is, a potentially stressful situation, and their perceived personal resources for meeting game-related demands. Participants were asked to indicate on a 7-point Likert scale the extent to which they agree or disagree with demand and resources statements. The Likert scale ranges from 1 *(strongly disagree)* to 7 *(strongly agree)* and pertains to demand statements such as "This task is demanding," "…is stressful," "…is distressing," "…is threatening," "…requires a lot of effort," and "I am uncertain how I will perform," and resources statements such as "I have the abilities to perform well," "performing well is important to me," "I am the

kind of person who does well on these tasks," "I have the expectations to perform well," and "this task is a positive challenge." Mendes et al. (2007) reported alphas of $\alpha = 0.79$ and $\alpha = 0.84$ for demand and resource items, respectively. Responses on each of the demand and resource subscales were averaged and used to create a stressful cognitive appraisal index by calculating a demands-to-resources ratio (Mendes et al., 2007).

Stress mindset. The stress mindset was evaluated using the stress mindset measure (SMM; Crum et al., 2013). The SMM contains eight questions assessing the participants' expectations or attributes of stress as facilitative or debilitative. The participants were asked to rate the extent to which they agree or disagree with the statements on a 5-point Likert scale ranging from 0 *(strongly disagree)* to 4 *(strongly agree)*. Items use the stem, "Experiencing stress…" and follow with sample items such as, "enhances my performance and productivity" (positive stress mindset), and "debilitates my performance and productivity" (negative stress mindset). Crum et al. (2013) report internal consistency alphas ranging from $\alpha = 0.80$ to 0.86, and criterion validity of .86. Scores were calculated by reverse scoring the four negative mindset items and thereafter averaging the eight items (Crum, Achor, Rothstein, & Salovey, 2013). Higher values indicate a more positive stress mindset.

Injury. Consistent with the sport injury literature (Ivarsson, Johnson, & Podlog, 2013; Rogers & Landers, 2005), injury was measured as a binary variable (injury occurrence or nonoccurrence) and defined as occurring when an athlete was restricted from participating or modified their participation in one or more days of training or competition after sustaining the original physical trauma. Modified participation denotes that an athlete was able to play following the physical trauma, but was required to wear

some supportive gear to do so (i.e., the athlete wore a brace or taped the injured area; Andersen & Williams, 1999). The team's medical staff reported injuries through an injury tracking sheet, which monitored whether a player was injured during the game and if that player missed or modified subsequent sport participation due to that injury. Researchers collected the injury tracking sheets the day after the game.

A secondary measure of injury was also assessed in a retrospective manner through self-report. Athletes reported if they had been injured at any time throughout the course of the preceding 12 months as a result of sport participation. Because a variety of other factors are implicated in sport injury occurrence, such as individual biomechanics or situational chance, collecting retrospective data allowed for examination of potential relationships between stress mindset, cognitive appraisals and previous injury occurrence.

Demographic intake. Basic demographic information was also collected including age, gender, level of sport participation, and previous injury history. In addition to general participant information, details about their sport experience were assessed, including questions such as "how many years have you played this sport?" and "what position do you play?"

Procedure

After receiving approval from the Institutional Review Board, potential participants were contacted and invited to partake in the study. At a designated team meeting, the lead researcher explained the study aims and 209 athletes who consented to participate completed the injury history and demographic information. Questionnaire completion took an average of 10 minutes. Within 4 hours of the start of their game, the participating athletes completed the cognitive appraisal (i.e., demands and resources)

questionnaire, requiring no more than 5 minutes. A regular season game was selected in conjunction with the team coach. Following the game, the team's athletic trainer or medical staff personnel used the injury tracking sheet to record injury data for each athlete, and shared that information with the researcher the day after each game. The researcher also examined public game statistic records to record time of exposure during the game for each participant. Exposure time was controlled for in the regression model examining the influence of mindset/appraisal on injury occurrence, given that athletes with more playing time (e.g., starters) may have been more likely to get hurt than those with diminished exposure (e.g., substitute players) regardless of anything related to appraisal.

Analysis

First, descriptive data (means and standard deviations) for all study variables were calculated. Bivariate correlations between variables of interest were then conducted. Finally, because the outcome variable, injury, was dichotomous (i.e., an athlete can either be injured or not injured), logistic regression analyses were conducted to test each of the three hypotheses. The logistic regression analyses provided an odds ratio representing the odds of an athlete being in the injured vs. noninjured group relative to their score on the cognitive appraisal and stress mindset predictor variables. If the predictors are unrelated to injury, the odds of that participant being in the injured group or noninjured group should be equal, representing an odds ratio of one. Conversely, for a variable such as cognitive appraisal, in which more stressful cognitive appraisals of the game are predicted to be associated with a greater likelihood of injury, the odds ratio would be expected to be greater than one (assessing research question number one). Additionally,

the logistic regression analysis was used to determine whether the stress mindset moderates the relationship between cognitive appraisals of a potentially stressful athletic event and prospective injury risk (question two). Logistic regression analyses were used to examine whether stress mindset or cognitive appraisal predicts previous injury occurrence (research question three). For example, for the stress mindset variable, in which higher or more facilitative levels of the variable are predicted to be associated with a decreased injury occurrence, the odds ratio is expected to be less than one.

RESULTS

Descriptive statistics on the demand and resource appraisals questionnaire revealed that the mean score for cognitive appraisals, or CA, was .742 ± .177 (*mean* ± *SD*; .14 = *low stress appraisals* and 7 = *high stress appraisal*) indicating low stress appraisals of the upcoming competition.

The mean for stress mindset, or SM, was 1.6 ± .54 (*mean* ± *SD*) on a scale ranging from 0 (*stress is debilitative*) to 4 (*stress is facilitating*), indicating that participants generally viewed stress as debilitative.

Hypotheses One and Two

To evaluate the prospective injuries that resulted in the observed game, the participant pool was screened again to include only participants who actually played for any duration during the game. This screening resulted in a sample size of 128 participants. Only four (3.125%) total prospective injuries occurred as a result of participating in the evaluated game, indicating that injury was a rare event.

Logistic regression was conducted examining the contribution of the predictor variables – stress appraisals and stress mindset – on prospective sport injury, indicating a significant model, χ^2 (3, 128) = 10.648, p = .014. However, there was no significant main effect for CA (B = 5.220, Wald χ^2 (1, 128) = .036, p = .851, *Exp(B)* = 184.924). Hypothesis one was therefore not supported. Similarly, no significant main effect for SM on injury occurrence was observed (B = 5.449, Wald χ^2 (1, 128) = .473, p = .492, *Exp(B)*

= 232.488).

With regard to hypothesis two, no significant interaction effect was observed for the influence of CA and SM on injury occurrence (B = -2.085, Wald χ^2 (1, 128) = .035, p = .853, *Exp(B)* = .124). Hypothesis two was also not supported.

Hypothesis Three

Of the 193 athletes examined, 116 (60.1%) participants reported having had an injury in the previous 12 months. Logistic regression analyses of cognitive appraisal and stress mindset on retrospective injury revealed a nonsignificant model, χ^2 (1, 193) = 3.478, p = .324. There were no significant main effects for either CA (B = 1.631, Wald χ2 (1, 193) = .409, p = .523, *Exp(B)* = 5.111), or SM (B = 1.359, Wald χ^2 (1, 193) = 1.198, p = .274, *Exp(B)* = 3.893). Likewise, there was no significant interaction effect for CA and SM on previous injury occurrence (B = -1.185, Wald χ^2 (1, 193) = .618, p = .458, *Exp(B)* = .306). Hypothesis three was not supported.

DISCUSSION

The purpose of this study was to investigate one of the mechanisms by which the stress response impacts the stress-injury relationship, as put forth by Williams and Andersen's (1988) stress-injury model. Specifically, this study tested the role of an athlete's cognitive appraisals of a stressful game situation and that athlete's likelihood of injury. The model posits that athletes are more apt to become injured if they appraise the game as more stressful, thereby increasing the prospect of injury. Furthermore, the present study examined the moderating role of a particular personality trait, the stress-mindset, on determining that relationship.

Injury occurring during the evaluated game was a rare event, as only 3.125% of the participating athletes sustained an injury. Even with such low numbers, a significant model indicated that cognitive appraisals, the stress mindset, and a potential interaction did in fact contribute to predicting the odds of an athlete becoming injured or not. However, because there were no significant main effects for either of the predictor variables, these relationships are difficult to interpret. With such a limited number of prospective injuries observed, it might be valuable to assess a larger sample size to determine if additional injuries would shed light on any potential relationships.

Given the data collected on cognitive appraisals, it is not surprising that such a minimal relationship would appear without significant main effects. The cognitive appraisals of the game were, overall, very low on the scale with a mean of .742 on a scale

ranging from .14 (*low stress appraisals*) to 7.0 (*high stress appraisals*), indicating that participants did not find the competitive match to be very stressful. Because the stress response is the primary mechanism through which the stress-injury model occurs, it is logical that, with low stress cognitive appraisals, there would be limited incidents of injury. Instead of assessing regular season games, as was done in the current study, it may prove more fruitful in future research to assess games that are more demanding, such as playoff matches or competitions between specific rivals, in order to elicit higher stress cognitive appraisals. Alternatively, examining athletes likely to feel they have fewer resources, such as freshman level athletes in their first year of collegiate sport, might also demonstrate more varied levels of cognitive appraisals. Without higher stress cognitive appraisals, it is difficult to support or refute the stress-injury hypotheses.

With cognitive appraisals of the competitive game indicating low stress levels, it is reasonable that no relationship would appear regarding the stress mindset. Moderating variables, such as the stress mindset personality trait, can only influence the stress-injury relationship in so much as there is an observable relationship between stress and injury to begin with. While previous research has examined direct relationships between moderating variables and injury (Fields et al., 1990; Ivarsson et al., 2013; Nigorikawa et al., 2003), the primary mechanism through which the stress-injury relationship occurs is through the stress response (Andersen & Williams, 1988; revised 1998). If the stress response is diminished due to low stress cognitive appraisals, then any potentially moderating variables are unlikely to play a significant role. Again, assessing a larger sample size and modifying the design to enhance the likelihood of varied and more stressful cognitive appraisals of the game might allow for richer information regarding

the role of the stress mindset on influencing the stress-injury relationship. Furthermore, with regard to the stress mindset in particular, a facilitative approach toward stress, or a positive stress mindset, is valuable for its ability to help people engage in behaviors to meet demands of a situation or even help people appraise situations as though they have more resources to use in a particular situation (Crum et al., 2013). With low stress cognitive appraisals, indicating appraisals of low demands or high resources, the value of the stress mindset is less essential.

Cognitive appraisals and stress mindset were also examined in relation to previous injury occurrence. Results investigating self-reported retrospective injury failed to support the hypothesis that cognitive appraisals and stress mindset would influence the stress-injury relationship; however, addressing some design limitations might demonstrate more fruitful results in the future. Similar to the prospective injury, a lack of high stress cognitive appraisals makes it difficult to support or refute the stress-injury hypotheses. Additionally, from a measurement standpoint, the demand and resource appraisal questionnaire is likely not the most reliable instrument for assessing participants' cognitive appraisals of competition in general considering the measure specifically focused on their upcoming game. The particular opponent of the game, the participant's likely starting status, the team's winning or losing record, or a host of other variables could easily have influenced participants' responses regarding that specifically-evaluated game. Utilizing a measure that evaluates cognitive appraisals of competition in general might prove a more reliable and valid instrument, and thus, provide more insightful results with regard to retrospective injury in particular.

While this study was the first attempt at investigating the role of cognitive

appraisals in predicting injury occurrence, future studies should examine cognitive appraisals in conjunction with physiological and attentional changes to more fully understand the stress-injury relationship. According to Williams and Andersen (1988), the stress response is a bidirectional relationship between cognitive appraisals and physiological and attentional changes in the body – a relationship where one is constantly modifying and remodifying the other. While the current study did not assess physiological or attentional changes during the game, it is possible that the low stress cognitive appraisals of the game served to limit or reduce any physiological or attentional changes, thereby decreasing the likelihood of injury. Assessing these bodily changes might provide a more comprehensive understanding of the stress-injury relationship and how cognitive appraisals influence that association.

Evaluating physiological and attentional changes might also provide insight into the possible influence of the stress mindset on the stress-injury relationship. The stress mindset has been shown to have a direct impact on physiological changes in the body under stress by influencing a person's cortisone levels, a stress hormone (Crum et al., 2013). Gathering information on changes in physiology in relation to the stress mindset and cognitive appraisals might serve to paint a more complete picture of such potential relationships on injury.

In addition to assessing physiological and attentional changes, future research should also aim to evaluate the impact of other stressors with which the athlete might be dealing. Certainly, today's athletes are faced with all kinds of stress in their daily lives, including major life event stress (Appaneal & Habif, 2013) and even daily hassles (Ivarsson et al., 2013), all of which have been suggested to influence the stress-injury

relationship. None of these types of stressors were assessed in the present study; however, the evidence suggesting their recurring role in injury occurrence warrants their inclusion.

Another limitation on which future research might capitalize is the measures used. In addition to the demands and resources questionnaire not being a reliable measure for appraisal of general competition for retrospective injury in particular, it also is not a sport-specific questionnaire. After a review of 10 years of stress-injury studies, Williams and Andersen (1998) posited that utilizing sport-specific questionnaires might yield more productive results. Moreover, crafting a design that allows for additional observation of potential injuries could be of benefit. Tracking injuries over the course of a season (Andersen & Williams, 1999; Rogers & Landers, 2005) or across a given number of sport-participated hours (Maddison & Prapavessis, 2005) have both demonstrated effective results in stress-injury research.

CONCLUSION

While results of the present study were nonsignificant, understanding the precursors to sport injury remains a crucial topic to both comprehend and ultimately prevent sport injury. There are a myriad of contributors to injury, such as individual body mechanics and situational luck; however, psychological variables – including stress – remain an important piece in comprehending a complete picture of injury occurrence and likelihood. Continued examination of this relationship is essential to help further inform the development of appropriate injury prevention strategies for collegiate athletes to be safer during their sport participation.

APPENDIX A

CONSENT LETTER

Consent Document

Background

You are being asked to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. Ask the researcher if there is anything that is not clear or if you would like more information.

The purpose of this study is to examine psychological factors that influence sport injury likelihood. Specifically, we are interested in how athletes appraise a potentially stressful athletic event, and if an athlete believes stress to be helpful or harmful to them. Stress is related to sport injury occurrence and, by investigating athletes' approach toward stress and appraisal of stressful athletic events, we hope to provide some strategies to help decease sport injury likelihood.

This study is being completed by Lindsey Hamilton. She is a Masters candidate studying sport and exercise psychology in the Department of Exercise and Sport Science at the University of Utah.

Procedures

It should take you about 15 minutes to the complete the study. You will be asked to complete a number of questionnaires before your athletic competition. Your coach will not be allowed to see the responses you provide. You will not put your name on the questionnaires. There are no right or wrong answers to the questions. You will be asked questions about your perception of the upcoming athletic event you are participating in, past injury experience (if any), and your approach toward stress in general. After your game, your team medical staff will be asked if any person on the team became injured at some point throughout the athletic event.

Risks

The risks of participating in this study are minimal. You may feel uneasy thinking about a sporting competition or past injury. These reactions are normal in athletic settings. If you feel upset from this experience, you can tell the researcher and she will assist you.

Benefits

There are no direct benefits for taking part in this study. However, we hope that the information we get from this study may help develop a greater understanding of how stress and approaches toward stress influence sport injury likelihood. This knowledge will be used to provide injury specialists and coaches with information on how to facilitate optimal psychological stress management strategies to decrease injury occurrence in sport.

Confidentiality

Your data will be kept confidential. Data and records will be stored in a locked filing cabinet or on a password protected computer located in the researcher's workspace. Only the researcher and members of his/her study team will have access to this information

Person to contact
If you have questions, complaints, or concerns about this study, you can contact Lindsey Hamilton at 510-219-7300 or via email at lindsey.hamilton@utah.edu.

Institutional review board
Contact the Institutional Review Board (IRB) if you have questions regarding your rights as a research participant. Also, contact the IRB if you have questions, complaints or concerns which you do not feel you can discuss with the investigator. The University of Utah IRB may be reached by phone at (801) 581-3655 or by e-mail at irb@hsc.utah.edu.

Research participant advocate
You may also contact the Research Participant Advocate (RPA) by phone at (801) 581-3803 or by email at participant.advocate@hsc.utah.edu.

Voluntary participation
It is up to you to decide whether to take part in this study. Refusal to participate or the decision to withdraw from this research will involve no penalty or loss of benefits to which you are otherwise entitled. This will not affect your relationship with the investigator or your team membership.

Costs and compensation to participants
There will be no cost or compensation to participants who participate in the study.

Consent
By completing the following questionnaires, you are giving your consent to participate. The researchers appreciate your participation in this study and thank you for your time.

APPENDIX B

STRESS MINDSET MEASURE

Please rate the extent to which you agree or disagree with the following statements:

The effects of stress are negative and should be avoided.

0	1	2	3	4
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Experiencing stress facilitates my learning and growth.

0	1	2	3	4
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Experiencing stress depletes my health and vitality.

0	1	2	3	4
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Experiencing stress enhances my performance and productivity.

0	1	2	3	4
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Experiencing stress inhibits my learning and growth.

0	1	2	3	4
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Experiencing stress improves my health and vitality.

0	1	2	3	4
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Experiencing stress debilitates my performance and productivity.

0	1	2	3	4
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

The effects of stress are positive and should be utilized.

0	1	2	3	4
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

APPENDIX C

DEMAND AND RESOURCE QUESTIONNAIRE

Please rate how strongly you agree or disagree with the following statements regarding your upcoming athletic event.

This game is demanding.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

This game is stressful.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

This game is distressing.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

This game is threatening.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

This game requires a lot of effort.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

I am uncertain how I will perform.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

I have the abilities to perform well.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

I have the expectations to perform well.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

Performing well is important to me.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

This game is a positive challenge.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

I am the type of person who does well in these games.

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

APPENDIX D

INJURY TRACKING SHEET

Injury Tracking Sheet

Please indicate, by marking yes or no, if any of the following athletes sustained an injury during the *(insert athletic event, e.g., soccer game)* on *(insert date of athletic event).*

****Note:** An injury is defined as a physical trauma sustained during the aforementioned athletic event that requires the athlete to refrain from participating in at least one subsequent game or practice, or if the athlete is able to play, but requires some type of modification (for example, if the athlete sprained an ankle, he/she must wear a brace or have their ankle taped for support).

Player ID Code	Yes, this athlete sustained an injury.	No, this athlete did not sustain an injury.
Athlete 1	□	□
Athlete 2	□	□
Athlete 3	□	□
Athlete 4	□	□
Athlete 5	□	□
Athlete 6	□	□
Athlete 7	□	□
Athlete 8	□	□
Athlete 9	□	□

APPENDIX E

DEMOGRAPHIC INTAKE

DEMOGRAPHICS

General Questions

Today's date: ……/……/……

Age: …… Sex (Circle one): Male Female

Sport Questions

Sport:
……

Years of participation in this sport: ……

Competitive level in this sport (Circle one):

Division I Division II Division III Junior College

Years competing at your current competitive level in this sport: ……

Primary position:
……

College or university you play for:
……

Current season's jersey number: ……

Injury History

In the <u>past year</u>, have you sustained an injury while participating in sport training and/or competition? To be considered an injury, it must have kept you from sport participation <u>for a minimum</u> of 1 day.

□ Yes □ No

Please indicate the resultant time loss from training and/or competition as a result of the injury:

Months: Weeks: Days:

REFERENCES

Abgarov, A., Jeffery-Tosoni, S., Baker, J., & Fraser-Thomas, J. (2012). Understanding social support throughout the injury process among interuniversity swimmers. *Journal of Intercollegiate Sport, 5*(2), 213-229.

Andersen, M. B., & Williams, J. M. (1988). A model of stress and athletic injury: Prediction and prevention. *Journal of Sport & Exercise Psychology, 10,* 294-306.

Andersen, M. B., & Williams, J. M. (1999). Athletic injury, psychosocial factors, and perceptual changes during stress. *Journal of Sports Sciences, 17,* 735-741.

Appaneal, R. N., & Habif, S. (2013). Psychological antecedents to sport injury. In M. Arvinen-Barrow and N. Walker (Eds.), *The psychology of sport injury and rehabilitation* (pp. 6-22). London: Routledge.

Cahill, L., Gorski, L., & Le, K. (2003). Enhanced human memory consolidation with post-learning stress: Interaction with the degree of arousal at encoding. *Learning & Memory, 10*(4), 270-274.

Crum, A., Achor, S., Rothstein, J., & Salovey, P. (2013). *Changing mindsets to harness the enhancing nature of stress.* Manuscript in preparation.

Crum, A. J., Salovey, P., & Achor, S. (2013). Rethinking stress: The role of mindsets in determining the stress response. *Journal of Personality and Social Psychology, 104*(4), 716-733.

Dekker, R., van ver Sluis, C., Groothoff, J., Eisma, W., & ten Duis, H. (2003). Long-term outcome of sports injuries: Results after inpatient treatment. *Clinical Rehabilitation, 17*(5), 480.

Devantier, C. (2011). Psychological predictors of injury among professional soccer players. *Sport Science Review, 20*(5/6), 5-36.

Evans, L., Hardy, L., & Fleming, S. (2000). Intervention strategies with injured athletes: An action research study. *The Sport Psychologist, 14,* 188–206.

Fields, K., Delaney, M., & Hinkle, J. (1990). A prospective study of type A behavior and running injuries. *The Journal of Family Practice, 30*(4), 425-429.

Ford, I. A., Eklund, R. C., & Gordon, S. (2000). An examination of psychosocial variables moderating the relationship between life stress and injury time-loss among athletes of a high standard. *Journal of Sports Sciences, 18,* 310-312.

Hancock, P. A., & Weaver, J. L. (2005). On time distortion under stress. *Theoretical Issues in Ergonomics Science, 6*(2), 193-211.

Hootman, J. M., Dick, R., & Agel, J. (2007). Epidemiology of collegiate injuries for 15 sports: Summary and recommendations for injury prevention initiatives. *Journal of Athletic Training, 42*(2), 311-319.

Ivarsson, A., Johnson, U., & Podlog, L. (2013). Psychological predictors of injury occurrence: A prospective investigation of competitive Swedish soccer players. *Journal of Sport Rehabilitation, 22,* 19-26.

Johnson, U. (2011). Athletes' experiences of psychosocial risk factors preceding injury. *Qualitative Research in Sport, Exercise and Health, 3*, 99-116.

Johnson, U., & Ivarsson, A. (2011). Psychological predictors of sport injuries among junior soccer players. *Scandinavian Journal of Medicine & Science in Sports, 21*, 129-136.

Lemberger, M. E. (2008). Systematic referrals: Issues and processes related to psychosocial referrals for athletic trainers. In J. M. Mensech & G. M. Miller (Eds.), *The athletic trainer's guide to psychosocial intervention and referral* (pp. 65-99). Thorofare, NJ: SLACK.

Maddison, R., & Prapavessis, H. (2005). A psychological approach to the prediction and prevention of athletic injury. *Journal of Sport & Exercise Psychology, 27*(3), 289.

Maffulli, N., Longo, U., Spiezia, F., & Denaro, V. (2010). Sports injuries in young athletes: Long-term outcome and prevention strategies. *The Physician and Sportsmedicine, 38*(2), 29-34.

Mendes, W., Gray, H. M., Mendoza-Denton, R., Major, B., & Epel, E. S. (2007). Why egalitarianism might be good for your health: Physiological thriving during stressful intergroup encounters. *Psychological Science, 18*(11), 991-998.

Nigorikawa, T., Oishi, K., Kamimura, M., Murayama, M., & Tanaka, N. (2003). Type A behavior pattern and sports injuries. *Japanese Journal of Physical Fitness and Sports Medicine, 52*, 359-368.

Nixon, H. L. (1994). Social pressure, social support, and help seeking for pain and injuries in college sports networks. *Journal of Sport & Social Issues, 18*(4), 340-355.

Noblet, A. J., & Gifford, S. M. (2002). The sources of stress experienced by professional Australian footballers. *Journal of Applied Sport Psychology, 14*, 1-13.

Norem, J. K., & Cantor, N. (1986). Defensive pessimism: Harnessing anxiety as motivation. *Journal of Personality And Social Psychology, 51*(6), 1208-1217.

Petrie, T. (1992). Psychosocial antecedents of athletic injury: The effects of life stress and social support on female collegiate gymnasts. *Behavioral Medicine* (Washington, D.C.), *18*(3), 127-138.

Podlog, L., & Eklund, R. C. (2006). A longitudinal investigation of competitive athletes' return to sport following serious injury. *Journal of Applied Sport Psychology, 18,* 44- 68.

Podlog, L., & Eklund. R. C. (2007). The psychosocial aspects of a return to sport following serious injury: A review of the literature. *Psychology of Sport and Exercise, 8,* 535-566.

Rogers, T. J., & Landers, D. M. (2005). Mediating effects of peripheral vision in the life events stress/athletic injury relationship. *Journal of Sport & Exercise Psychology, 27,* 271-288.

Schneiderman, N., Ironson, G., & Siegel, S. D. (2005). Stress and health: Psychological, behavioral, and biological determinants. *Annual Review of Clinical Psychology, 1*(1), 607-628.

Schwab Reese, L. M., Pittsinger, R., & Yang, J, (2012). Effectiveness of psychological intervention following sport injury. *Journal of Sport and Health Science, 1*, 71-79.

Smith, R. E., Smoll, F. L., & Ptacek, J. T. (1990). Conjunctive moderator variables in vulnerability and resiliency research: Life stress, social support and coping skills, and adolescent sport injuries. *Journal of Personality and Social Psychology, 58,* 360-369.

Wiese-Bjornstal, D. M. (2010). Psychology and socioculture affect injury risk, response, and recovery in high-intensity athletes: a consensus statement. *Scandinavian Journal of Medicine & Science in Sports, 20*, 103-111.

Williams, J. M. (2001). Psychology of injury: Risk and prevention. In R. N. Singer, H. A. Hausenblas, & C. Janelle (Eds.), *Handbook of sport psychology* (pp. 766-786). New York: John Wiley.

Williams, J. M., & Andersen, M.B. (1998). Psychosocial antecedents of sport injury: Review and critique of the stress injury model. *Journal of Applied Sport Psychology, 10,* 5-25.